CLAIM + DETAILED DESCRIPTION

[Claim(s)]

[Claim 1] The compound material particles which mix metallic powder and crystalline carbon material and are obtained a pressurization miniaturization and by making it decode.

[Claim 2] The compound material particle according to claim 1 whose mixed rates of metallic powder and crystalline carbon material are the crystalline carbon material 1 - 200 weight parts to a metallic powder 100 weight part.

[Claim 3] The compound material particle according to claim 1 or 2 which is one kind chosen from the powder of the alloy with which metallic powder contains the metal chosen from the powder or said group of the metal chosen from the group which consists of Fe, Cu, aluminum, Ag, Be, Mg, W, nickel, Mo, Si, and Zn, or two kinds or more.

[Claim 4] The compound material particle according to claim 1 to 3 whose crystalline carbon material is one kind chosen from black lead, carbon fiber, carbon black, fullerene, or a carbon nanotube, or two kinds or more.

[Claim 5] High-fever conductivity compound material obtained by carrying out hot press molding of the compound material particle according to claim 1 to 4.

[Claim 6] High-fever conductivity compound material which has the organization which the metallic powder whose mean particle sizes are 5 micrometers - 1nm distributed to the crystalline carbon matrix.

[Claim 7] High-fever conductivity compound material according to claim 6 obtained by carrying out hot press molding of the compound material particle according to claim 1 to 4.

[Claim 8] The manufacturing process of the compound material particles which mix metallic powder and crystalline carbon material and pressurization miniaturization - Make decode.

[Claim 9] The manufacturing process of the compound material particle according to claim 8 whose mixed rates of metallic powder and crystalline carbon material are the crystalline carbon material 1 - 200 weight parts to a metallic powder 100 weight part.

[Claim 10] The manufacturing process of the compound material particle according to claim 8 or 9 which is one kind chosen from the powder of the alloy with which metallic powder contains the metal chosen from the powder or said group of the metal chosen from the group which consists of Fe, Cu, aluminum, Ag, Be, Mg, W, nickel, Mo, Si, and Zn, or two kinds or more.
[Claim 11] The manufacturing process of the compound material particle according to claim 8 to 10 whose crystalline carbon material is one kind chosen from black lead, carbon fiber, carbon black, fullerene, or a carbon nanotube, or two kinds or more.
[Claim 12] The manufacturing process of the compound material particle according to claim 8 to 11 which perform a pressurization miniaturization and composite-ization with metallic powder and crystalline carbon material by a ball mill.
[Claim 13] The manufacturing process of the compound material particle according to claim 8 to 12 which perform a pressurization miniaturization and composite-ization with metallic powder and crystalline carbon material at low temperature of 40 degrees C or less among inactive gas atmosphere.
[Claim 14] The manufacturing process of the high-fever conductivity compound material which carries out hot press molding of the compound material particle according to claim 1 to 4.
[Claim 15] The manufacturing process of the high-fever conductivity compound material according to claim 14 which performs hot press molding at 20-1500 degrees C among an inactive atmosphere.

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to high-fever conductivity compound material and its manufacturing process. This invention relates to a compound material particle suitable as a charge of manufacture material of high-fever conductivity compound material, and its manufacturing process. The high-fever conductivity compound material of this invention is useful as a construction material as which the high-fever conductivity of thermal machines, such as a heat dispersion board for electric circuit protection, a heat exchanger, and heat pump, is required.
[0002]
[Description of the Prior Art] As the thermal machine accompanied by the phenomenon of heat exchange and heat transfer, or general-purpose heat conduction material for heat dispersions, cast iron, stainless steel, copper and a copper alloy, aluminum and an aluminium alloy, nickel and a nickel alloy, titanium and the titanium alloy, the zirconium alloy, etc. are mainly used conventionally. Copper, aluminum, etc. with the highest thermal conductivity are used for thermal machines, such as a heat exchanger as which high-fever conductivity is required

especially, over the temperature range from normal temperature to high temperature.

[0003] However, in modern society, while the requests to the technology of energy saving are mounting increasingly, the thermal machine which has higher thermal conductivity or thermal efficiency is called for, and it is necessary to develop the general-purpose heat conduction material which has higher thermal conductivity compared with copper, aluminum, etc. Moreover, there is a problem also in points, such as the wettability of a medium and metal, and acidity or the corrosiveness of the metal by an alkaline medium, in the thermal machine which makes metal, such as copper and aluminum, heat conduction material.

[0004]

[Problem(s) to be Solved by the Invention] The purpose of this invention is set to thermal machines, such as a heat dissipation board for electric circuit protection, a heat exchanger, and heat pump. It is in offering the high-fever conduction material which has high-fever conductivity, and is in offering the new high-fever conduction material which has still higher hydrophilicity and corrosion resistance so that it can become alternate material currently used conventionally, such as copper and aluminum.

[0005]

[Means for Solving the Problem] When this invention persons make crystalline carbon material, such as black lead in which thermal conductivity is higher than copper, and carbon fiber, and various metal decode by a specific method wholeheartedly in view of the aforementioned purpose as a result of examination It found out that the compound material of carbon and metal which has high thermal conductivity more than 2 double rather than the copper currently generally used for the thermal machine is obtained, and that the compound material which made the crystalline carbon matrix distribute metallic powder minutely especially had high-fever conductivity.

[0006] this invention -- metallic powder (for example, Fe, Cu, aluminum, Ag, Be, and Mg --) One kind or two kinds or more, and crystalline carbon material which were chosen from the powder of the alloy containing the metal chosen from the powder or said group of the metal chosen from the group which consists of W, nickel, Mo, Si, and Zn (For example, one kind or two kinds or more which were chosen from black lead, carbon fiber, carbon black, fullerene, or a carbon nanotube) (as opposed to for example, a metallic powder 100 weight part -- mixed rate of the crystalline carbon material 1 - 200 weight parts) it mixes and is related with the compound material particle obtained and its manufacturing process a pressurization miniaturization and by making it decode.

[0007] This invention relates to the high-fever conductivity compound material obtained by carrying out hot press molding of the compound material particle concerned, and its manufacturing process. This invention relates to the high-fever conductivity compound material which has the organization which the metallic powder whose number mean particle sizes are 5

micrometers - 1nm distributed to the crystalline (for example, obtained by carrying out hot press molding of said compound material particle) carbon matrix.

[0008] In the new field as which performances, such as corrosiveness and hydrophilicity, are required, it not only can use the high-fever conductivity compound material of this invention as alternative material for the thermal machine which is using conventional copper, aluminum, etc., but it can demonstrate the characteristic.

[0009]

[Embodiment of the Invention]

As compound material particle metallic powder, the powder of the alloy containing one or more kinds of metal simple substances or such metal, such as Fe, Cu, aluminum, Ag, Be, Mg, W, nickel, Mo, Si, and Zn, can be used. Metallic powder is independent in one kind, or can mix and use two or more kinds. The high compound material of thermal conductivity can be obtained more by using powder, such as the high metallic powder of thermal conductivity, for example, Cu, Ag, aluminum, and Be.

[0010] As crystalline carbon material, natural graphite, artificial composition black lead, carbon fiber, fullerene, a carbon nanotube, and the carbon material that has other crystallinity can be used. Crystalline carbon material can be used as powder or a staple. Crystalline carbon is independent in one kind, or can mix and use two or more kinds. The high compound material of thermal conductivity can be obtained more by using crystalline good carbon material, for example, natural graphite, artificial composition black lead, etc.

[0011] Although there is no limitation in particular about the mixed rate of metallic powder and crystalline carbon material, the compound material with easy fabrication in which thermal conductivity is high can be obtained to the metallic powder 100 weight part in a materials constituent the crystalline carbon material 1 - 200 weight parts, and by considering it as a 10 - 100 weight part preferably. With the form of desirable operation, it is compound material particles in the alloyed powder end of the carbon/metal with which metallic powder and crystalline carbon material were pressurized and compounded, and the mean particle sizes of the metallic powder in a carbon matrix are 5 micrometers - 1nm.

[0012] The pressurization miniaturization and composite-ization of a mixed material of metallic powder and crystalline carbon material can be carried out what is called by carrying out mechanical alloying processing. Mechanical alloying processing can be carried out mixture and by carrying out **** using a ball mill. With the form of desirable operation, the pressurization miniaturization and composite-ization of a mixed material are performed so that the mean particle size of the metal particles in the carbon matrix of the compound material particles obtained may be set to 5 micrometers - 1nm.

[0013] It is desirable to carry out the pressurization miniaturization and composite-ization of a mixed material in inactive gas atmosphere, and it is preferably desirable to carry out at low

temperature of 0 degree C or less preferably especially 30 degrees C or less 40 degrees C or less. By carrying out the pressurization miniaturization and composite-ization of a mixed material at low temperature of 30 degrees C or less among inactive gas atmosphere In a carbon matrix, metal particles can manufacture efficiently the compound material distributed uniformly, and especially it among inactive gas atmosphere [low temperature of 0 degree C or less] For example, among argon gas atmosphere, by carrying out cooling by liquid nitrogen, it is convenient in order to be able to manufacture much more detailed compound material particles and to manufacture high-fever conductivity compound material.
[0014] If carry out adequate amount combination, metallic powder and crystalline carbon material are made intermingled and the end of these mixed powder is pressurized, while detailed mixture will advance and the homogeneity of each particle will increase, functionality is added to the character which each particle has, and the alloy particles which have higher performance and functionality, i.e., compound material particles, generate. If a high energy ball mill etc. is used and especially pressurization is carried out what is called by mechanical alloying processing It is processed, it becomes flat [-like] and a new field is exposed, and these new fields are forge-welded, it comes to unite, this is repeated, a miniaturization and uniformity advance further according to collision / compression impulse force, and the compound material particles which have the detailed structure of a below micron nm order generate each particle.
[0015] High-fever conductivity compound material can be manufactured by carrying out forming processing of the high-fever conductivity compound material compound material particles. The high-fever conductivity compound material which has especially the characteristic which was excellent in the compound material particles of this invention hot press molding, i.e., by carrying out heating / pressurization fabrication, can be manufactured. Hot press molding of compound material particles can be carried out at 20-1500 degrees C among an inactive atmosphere.
[0016] In the process which obtains high-fever conductivity compound material by carrying out hot press molding of the compound material particles The more it is important to perform hot press molding in inactive gas atmosphere and under a suitable temperature and compacting pressure is high, more precise compound material can be manufactured and, the more high-fever conductivity compound material with the good characteristics, such as thermal conductivity and machine intensity, can be obtained. For example, the high-fever conductivity compound material which has 2.3-time-as much thermal conductivity as a copper plate can be manufactured by fabricating the copper / black lead alloy powder manufactured from copper powder and natural graphite powder at 800 degrees C by the pressure of 10000kg/cm2 among argon atmosphere.
[0017]

[Example] The work example and comparative example of this invention are shown below, and the place by which it is characterized [of this invention] is clarified further. [0018] A natural graphite (shape of powder, 99% of purity) 10 weight part is blended with a work-example 1 copper powder (100 micrometers of diameter of particle, 99.8% of purity) 90 weight part, and it mixes. The stainless steel ball of the end of these mixed powder and 100 weight parts was taught to the stainless steel container with a content volume of 200ml, and what is called mechanical alloying processing was performed for 12 hours, cooling by liquid nitrogen among an argon gas air current by an oscillating ball mill. Where air is intercepted by 800 degrees C and the pressure of 10000kg/cm2, hot press molding of the obtained alloy particles was carried out to disc-like. The thermal conductivity according the obtained disc-like sample to a laser Frasch process at room temperature was measured. The result is shown in Table 1.

[0019] A natural graphite (shape of powder, 99% of purity) 30 weight part is blended with a work-example 2 copper powder (100 micrometers of diameter of particle, 99.8% of purity) 70 weight part, and it mixes. The stainless steel ball of the end of these mixed powder and 100 weight parts was taught to the stainless steel container with a content volume of 200ml, and mechanical alloying processing was performed on the same conditions as a work example 1. The thermal conductivity according the obtained disc-like sample to a laser Frasch process at room temperature was measured. The result is shown in Table 1.

[0020] A natural graphite (shape of powder, 99% of purity) 50 weight part is blended with a work-example 3 copper powder (100 micrometers of diameter of particle, 99.8% of purity) 50 weight part, and it mixes. The stainless steel ball of the end of these mixed powder and 100 weight parts was taught to the stainless steel container with a content volume of 200ml, and mechanical alloying processing was performed on the same conditions as a work example 1. The thermal conductivity according the obtained disc-like sample to a laser Frasch process at room temperature was measured. The result is shown in Table 1.

[0021] A natural graphite (shape of powder, 99% of purity) 30 weight part is blended with 70 weight parts in the end (200 micrometers of diameters of a particle, 99.9% of purity) of work-example 4 aluminium powder, and it mixes. The stainless steel ball of the end of these mixed powder and 100 weight parts was taught to the stainless steel container with a content volume of 200ml, and mechanical alloying processing was performed on the same conditions as a work example 1. The thermal conductivity according the obtained disc-like sample to a laser Frasch process at room temperature was measured. The result is shown in Table 1.

[0022] A natural graphite (shape of powder, 99% of purity) 30 weight part is blended with 70 ****** in the end (the diameter 20 of a particle - 60mesh, 99.9% of purity) of work-example 5 iron powder, and it mixes. The stainless steel ball of the end of these mixed powder and 100 weight parts was taught to the stainless steel container with a content volume of 200ml, and mechanical alloying processing was performed on the same conditions as a work example 1.

The thermal conductivity according the obtained disc-like sample to a laser Frasch process at room temperature was measured. The result is shown in Table 1.
[0023] An artificial black lead (thing, shape of powder, 99% of purity which were manufactured from petroleum coke) 30 weight part is blended with a work-example 6 nickel powder (Type287, 99.0% of purity) 70 weight part, and it mixes. The stainless steel ball of the end of these mixed powder and 100 weight parts was taught to the stainless steel container with a content volume of 200ml, and mechanical alloying processing was performed on the same conditions as a work example 1. The thermal conductivity according the obtained disc-like sample to a laser Frasch process at room temperature was measured. The result is shown in Table 1.
[0024] The copper powder (100 micrometers of diameters of a particle, 99.8% of purity) of a comparative example 1100 weight part and the stainless steel ball of 100 weight parts are taught to a stainless steel container with a content volume of 200ml, What is called mechanical alloying processing was performed for 12 hours, cooling by liquid nitrogen among an argon gas air current by oscillating Paul Mill. Where air is intercepted by 800 degrees C and the pressure of 10000kg/cm2, hot press molding of the obtained alloy particles was carried out disc-like. The thermal conductivity according the obtained disc-like sample to a laser Frasch process at room temperature was measured. The result is shown in Table 1.
[0025] The stainless steel ball of the aluminium powder end of a comparative example 2100 weight part (200 micrometers of diameters of a particle, 99.9% of purity) and a 100 weight county was taught to the stainless steel container with a content volume of 200ml, and mechanical alloying processing was performed on the same conditions as a comparative example 1. Where air is intercepted by 800 degrees C and the pressure of 10000kg/cm2, hot press molding of the obtained alloy particles was carried out disc-like. The thermal conductivity according the obtained disc-like sample to a laser Frasch process at room temperature was measured. The result is shown in Table 1.
[0026] The stainless steel ball of the iron powder end of a comparative example 3100 weight part (the diameter 20 of a particle - 60meSh, 99.9% of purity) and 100 ****** was taught to the stainless steel container with a content volume of 200ml, and mechanical alloying processing was performed on the same conditions as a comparative example 1. Where air is intercepted by 800 degrees C and the pressure of 10000kg/cm2, hot press molding of the obtained alloy particles was carried out disc-like. The thermal conductivity according the obtained disc-like sample to a laser Frasch process at room temperature was measured. The result is shown in Table 1.
[0027] The nickel powder (Type287, 99.0% of purity) of a comparative example 4100 weight part and the stainless steel ball of 100 weight parts were taught to the stainless steel container with a content volume of 200ml, and mechanical alloying processing was performed on the

same conditions as a comparative example 1. Where air is intercepted by 800 degrees C and the pressure of 10000kg/cm2, hot press molding of the obtained alloy particles was carried out disc-like. The thermal conductivity according the obtained disc-like sample to a laser Frasch process at room temperature was measured. The result is shown in Table 1.

[0028]

[Table 1]

表 1

実施例	組　　成	熱伝導率(W/m°K)
実施例1	天然黒鉛／銅＝１０／９０	５２６
実施例2	天然黒鉛／銅＝３０／７０	７９９
実施例3	天然黒鉛／銅＝５０／５０	９６３
実施例4	天然黒鉛／アルミニウム＝３０／７０	４９３
実施例5	天然黒鉛／鉄＝３０／７０	１４９
実施例6	人造黒鉛／ニッケル＝３０／７０	１７３
比較例1	銅＝１００％	３９１
比較例2	アルミニウム＝１００％	２３５
比較例3	鉄＝１００％	７８．５
比較例4	ニッケル＝１００％	８８．６

[0029]

[Effect of the Invention] According to this invention, thermal conductivity compound material as high than a mere metal as more than 2 double is obtained. The high-fever conductivity compound material of this invention is excellent also in the characteristics, such as corrosiveness-proof, hydrophilicity, and machine intensity. Since the high-fever conductivity compound material of this invention has high-fever conductivity and can moreover process various form, it is useful as a construction material as which the high-fever conductivity of thermal machines, such as a heat dispersion board for electric circuit protection, a heat exchanger, and heat pump, is required.

[Translation done.]